

# Carotid Endarterectomy in Patients with Asymptomatic Intracranial Aneurysm

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The patient with symptomatic extracranial carotid artery disease who, on angiography, is found to have a coexisting intracranial aneurysm presents a therapeutic dilemma. Relief of the carotid stenosis, with a potential increase in cerebral blood pressure, might increase the risk of aneurysm rupture. Conversely, repair of the aneurysm may be hazardous because of the low flow imposed by the carotid stenosis, particularly in the event of perioperative hypotension. We reviewed 19 patients treated with 20 carotid endarterectomies in the face of concurrent asymptomatic intracranial aneurysm. There were no instances of aneurysm rupture during the operation or the 30 days following operation. The literature reported to date consists of a total of 20 patients with only one incidence of aneurysm rupture in the postoperative period. We conclude that carotid endarterectomy is unlikely to precipitate rupture of an intracranial aneurysm during the operation or postoperative period.

FIVE PER CENT OF PATIENTS who undergo cerebral angiography for evaluation of extracranial vascular disease will be found to have an incidental intracranial aneurysm.<sup>1-3</sup> In the patient with symptomatic carotid stenosis requiring endarterectomy, this presents a dilemma to the vascular surgeon.

The risk of bleeding from an asymptomatic intracranial aneurysm has been estimated at 10% to 17% during a 5-year follow-up.<sup>4,5</sup> In view of the natural history of this lesion, an increasing number of neurosurgeons recommend elective clipping of an incidentally discovered intracranial aneurysm.<sup>6-9</sup> During repair of the intracranial aneurysm, inadequate cerebral blood flow may occur secondary to the carotid stenosis. Further reduction in cerebral blood flow may result from the deliberate intraoperative hypotension that is used routinely to facilitate neurosurgical dissection.

Conversely, repair of the carotid stenosis may expose the intracranial aneurysm to an increased arterial pressure, and, theoretically, an increased risk of rupture.<sup>10</sup> In fact, it has been suggested that partial carotid occlusion may

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impart a protective effect upon an aneurysm distal to the occlusion. Reduction in the size of intracranial aneurysms has been documented following intentional partial carotid occlusion.<sup>11</sup> For this reason, vascular surgeons may be reluctant to correct carotid stenosis in the face of a concurrent intracranial aneurysm. In an effort to define a therapeutic approach to this dilemma, we reviewed all carotid endarterectomies performed at the University of Pittsburgh in patients with carotid stenosis and a coexisting asymptomatic intracranial aneurysm from January 1973 through June 1983.

## Methods and Results

Patients with suspected carotid disease underwent angiography of both cervical carotid arteries and intracranial vessels by selective injection. Biplane views were taken of each vessel. Nineteen patients with symptomatic carotid stenosis were also found to have coexisting asymptomatic intracranial aneurysms. In this group, 20 carotid endarterectomies were performed (Table 1). Eleven operations were performed under regional anesthesia as previously described,<sup>12,13</sup> while nine were performed under general anesthesia with EEG monitoring. There were seven men and twelve women ranging in age from 50 to 82 years. The aneurysm was located on the ipsilateral side in ten endarterectomies, contralateral side in nine cases, and in the basilar artery in one patient. One aneurysm was greater than 2.5 centimeters in diameter while the others were less than 2.5 centimeters in diameter. The follow-up period after endarterectomy ranged from 1 month to 10 years. There were no episodes of aneurysm rupture during the operative procedure or in the first 30 days following operation in any patient.

Ten patients underwent carotid endarterectomy with an ipsilateral aneurysm. Eight are well at 1 to 10 years

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TABLE 1. *Patients with Asymptomatic Intracranial Aneurysms Undergoing Carotid Endarterectomy*

Patient #	Sex	Age (Years)	Carotid Endarterectomy	Location of Aneurysm	Outcome
1	F	67	Left	L MCA*	Well at 2 years
2	F	53	Left	L MCA	Well at 7 years
3	M	60	Right	R ICA†	Died of myocardial infarction 2 months after surgery
4	M	71	Left and right	L MCA	Well at 2 years
5	M	66	Left	R MCA (giant)	Died at 1 year without rupture of aneurysm
6	M	50	Left	R PCoA‡	Well at 4 years
7	F	58	Left	R cavernous	Died at 10 months without rupture of aneurysm
8	F	57	Right	Basilar artery	CVA§ postop IA   clipping, survived
9	F	54	Right	R PCoA	Well at 5 years
10	M	68	Left	R cavernous	Well at 2 years
11	F	59	Right	R cavernous	Well at 4 years
12	F	73	Right	L cavernous	Well at 6 years
13	M	69	Left	L PCoA	Well at 10 years
14	F	60	Right	R MCA	IA clipped postendarterectomy Well at 1 year
15	F	57	Left	R ACA¶ L MCA L PCoA R PCoA	3 of 4 IAs Clipped pre-endarterectomy Well at 1 month
16	F	82	Left	L PCoA	Well at 1 year
17	F	59	Right	L PCoA	CVA postop IA clipping, survived
18	F	60	Left	L cavernous	Well at 1 month
19	M	69	Left	R MCA	Well at 1 month

\* MCA—Middle cerebral artery.

† ICA—Internal carotid artery.

‡ PCoA—Posterior communicating artery.

§ CVA—Cerebral vascular accident.

|| IA—Intracranial aneurysm.

¶ ACA—Anterior communicating artery.

follow-up including one who underwent uneventful repair of the intracranial aneurysm. One is well at 1 month, and one patient died of myocardial infarction 2 months after surgery. Nine patients underwent carotid endarterectomy with a contralateral intracranial aneurysm. (This includes one patient who underwent bilateral carotid endarterectomy and was, therefore, also included in the previous group as having an ipsilateral aneurysm at risk.) Four are alive and well at 1 to 10 years follow-up, two are well at 1 month, and two died of unknown causes at 10 and 12 months, respectively, without symptoms of cerebrovascular disease. One of these nine underwent uneventful carotid endarterectomy but had an intraoperative hemorrhage during elective aneurysm repair 2 months later. The patient with a basilar artery aneurysm also underwent uneventful carotid endarterectomy but de-

veloped intracranial hemorrhage 3 months later during elective aneurysm clipping. In no patient was there an episode of documented intracranial aneurysm rupture.

### Discussion

The patient with symptomatic extracranial carotid artery stenosis who is found to have an incidental intracranial aneurysm has two lesions with indications for surgical correction. Elective clipping of the aneurysm may carry increased risk of intraoperative cerebral ischemia due to the diminished cerebral perfusion imposed upon the intracranial circulation by the carotid stenosis, particularly if deliberate hypotension is employed during intracranial dissection. Conversely, repair of the carotid stenosis prior to aneurysm clipping may expose the aneu-

TABLE 2. *Previously Reported Symptomatic Carotid Stenosis with Intracranial Aneurysm*

Author	Number of Patients	Presenting Symptoms	Lesion Undergoing Initial Repair	Postoperative Strokes
Fields (1970) <sup>15</sup>	2	TIA*	Carotid	0
	1	aSx† bruit	Neither	0
	1	SH‡	Carotid	0
	1	SH and TIA	Carotid	0
Portnoy (1970) <sup>14</sup>	1	TIA	Carotid	0
Denton (1973) <sup>18</sup>	1	TIA	Carotid	0
Shoumaker (1976) <sup>19</sup>	1	TIA	Carotid	0
Adams (1977) <sup>10</sup>	1	TIA	Carotid	1 at 7 months
Stern (1979) <sup>16</sup>	15	TIA	Carotid	0
	4	SH	IA§ (3)	0
			Carotid (1)	1
	1	CN III palsy from IA	IA	0

\* TIA—Transient ischemic attack.

† aSx—Asymptomatic.

‡ SH—Subarachnoid hemorrhage.

§ IA—intracranial aneurysm.

rysm to increased pressure and a theoretically increased risk of rupture.

The previously reported experience with this combination of lesions is summarized in Table 2. Portnoy<sup>14</sup> reported a case of symptomatic intracranial aneurysm, with a contralateral carotid stenosis that became symptomatic at the induction of hypotension. Fields<sup>15</sup> reported a patient with an asymptomatic bruit who was found to have both carotid stenosis and intracranial aneurysm on angiography. In the same report, a patient presenting with subarachnoid hemorrhage was found to have contralateral carotid stenosis that was repaired in preparation for the eventuality that carotid artery ligation would be required on the side of the intracranial aneurysm. Stern<sup>16</sup> presented five patients with subarachnoid hemorrhage and asymptomatic carotid stenosis, four of whom underwent successful aneurysm clipping prior to uneventful carotid endarterectomy. The fifth patient underwent carotid endarterectomy on the side contralateral to the symptomatic intracranial aneurysm and suffered fatal rupture of the aneurysm in the postoperative period.

Pool and Potts, in 1965, recommended that the patient with intracranial aneurysm and contralateral carotid stenosis be treated with correction of the carotid stenosis followed by treatment of the intracranial aneurysm. Most of the reported cases of symptomatic carotid stenosis and incidental intracranial aneurysm have been managed following this advice.<sup>17</sup> Adams<sup>10</sup> presented a case of symptomatic carotid stenosis with an incidental intracranial aneurysm who, 7 months after repair of the carotid stenosis, suffered fatal subarachnoid hemorrhage. Denton<sup>18</sup> pursued an aggressive and undelayed approach to the repair of the asymptomatic intracranial aneurysm after carotid endarterectomy in his patient. Shoumaker,<sup>19</sup> on the other hand, reported a patient who underwent uneventful carotid endarterectomy for a symptomatic lesion despite the presence of intracranial aneurysms. Follow-

up angiography at 7 months documented no increase in the size of the aneurysm, and on this basis, aneurysm repair was not recommended. Likewise, the two patients in Fields' report who underwent carotid endarterectomy in the face of asymptomatic intracranial aneurysm had angiography 1 year after operation that documented no change in the size of the aneurysm. In the remaining 15 patients with symptomatic carotid stenosis and incidental intracranial aneurysm reported by Stern,<sup>16</sup> all underwent carotid endarterectomy. Five of these patients had postoperative angiography documenting no change in the size of their aneurysms. All 15 were free of subarachnoid hemorrhage symptoms at 6 months to 8 years following carotid endarterectomy. Only one underwent intracranial aneurysm clipping following endarterectomy.

We have reviewed the literature and found a single case of rupture of intracranial aneurysm 7 months following carotid endarterectomy. Twenty patients have been reported with symptomatic carotid lesions and incidental intracranial aneurysm. All underwent carotid endarterectomy in the face of asymptomatic aneurysm, and none suffered immediate postoperative intracranial aneurysm rupture. To this collective experience we add our experience of 20 carotid endarterectomies performed for symptomatic carotid stenosis in the face of incidental intracranial aneurysm. None of our patients had symptoms of rupture or dilatation of their intracranial aneurysms following endarterectomy.

### Conclusion

We conclude that the patient with symptomatic extracranial carotid stenosis and an incidental intracranial aneurysm can be managed by carotid endarterectomy without an increased risk of rupture of the aneurysm with repair of the carotid stenosis or in the first postoperative month. Furthermore, in the 15 patients with aneurysms

not repaired following carotid endarterectomy, none has ruptured while followed up to 10 years.

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